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EXAMINER	
ROBERTS, MICHAEL P	

ART UNIT	PAPER NUMBER
2873	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/08/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/783,525	SALIB, MICHAEL S.	
	Examiner	**Art Unit**	
	Michael P. Roberts	2873	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 20 February 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-28 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-28 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 20 February 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 20050718 and 20040220.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Specification

The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) TITLE OF THE INVENTION.
(b) CROSS-REFERENCE TO RELATED APPLICATIONS.
(c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
(d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
(e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
(f) BACKGROUND OF THE INVENTION.
 (1) Field of the Invention.
 (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(g) BRIEF SUMMARY OF THE INVENTION.
(h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
(i) DETAILED DESCRIPTION OF THE INVENTION.
(j) CLAIM OR CLAIMS (commencing on a separate sheet).
(k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
(l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

1. The disclosure is objected to because of the following informalities: the specification does not include a "Brief Summary of the Invention" section. Appropriate correction is required.

2. The abstract of the disclosure is objected to because it is longer than 150 words. Correction is required. See MPEP § 608.01(b).

Claim Objections

3. **Claim 19** is objected to because of the following informalities: the second line reads, "modulated regions the in second semiconductor material, " and is therefore grammatically incorrect. The phrase should read, "modulated regions in the second semiconductor material." Appropriate correction is required.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. **Claims 1-6, 8, 10, and 12-19** are rejected under 35 U.S.C. 103(a) as being unpatentable over Tokushima (US 6,466,360, hereinafter Tokushima '360) in view of Matsuura et al. (US 2004/0213534, hereinafter Matsuura '534).

7. Regarding **claim 1**, Tokushima '360 discloses an apparatus (title; abstract) comprising: a photonic crystal lattice in a first semiconductor material (Fig. 2; col. 5, lines 9-48, wherein the photonic crystal lattice is made up of elongated elements 11 formed of GaAs), the first semiconductor material having a plurality of holes (bores filled with air 13 located between the vertical elements 11) defined in the first semiconductor material (Figs. 2, 3; col. 5, lines 9-48, wherein the first dielectric semiconductor material GaAs has a plurality of air filled bores 13 defined therein), the plurality of holes periodically arranged in the first semiconductor material with a hole pitch and a hole radius to define the crystal lattice structure (Fig. 2; col. 1, lines 24-30, 40-54; col. 4, lines 1-10, wherein the hole pitch is represented with the lattice constant a and the hole radius is represented with the radius r); second semiconductor material regions (dielectric layer 24, made of second dielectric material 12, SiO2) disposed proximate to and insulated from respective inside surfaces of the plurality of holes defined in the first semiconductor material (Figs. 2, 3; col. 5, lines 9-48; col. 6, lines 33-40, wherein the second semiconductor material region 24 between the two middle elements 11 in Fig. 3C-1 is insulated from the inside surfaces of the plurality of holes defined by the first semiconductor material GaAs and elongated elements 11), but does not specifically disclose charge modulated regions to be modulated in the second semiconductor material regions, wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic

band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions.

In the same field of endeavor of photonic crystal lattice devices, Matsuura '534 teaches charge modulated regions to be modulated in the second semiconductor material regions (Figs. 1-15; sections 0019, 0022-25, 0029-0032, 0059, wherein the charge modulated regions are the pillars 31), wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions (Figs. 1-15; sec. 0002, 0007-0009, 0019, 0022-25, 0029-0032, 0059, wherein the beam that is directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap, the effective photonic band gap modulated in response to the deformation or movement of the pillars 31 which are electrically modulated), for the purpose of providing the ability to selectively introduce or remove defects in the photonic crystal, therefore compensating for natural imperfections and permitting the propagation, confinement, or both of selected wavelengths, and allowing modes of light in the structure to be changed or tuned (sec. 0022-0025, 0063).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the apparatus of Tokushima '360 to further comprise charge modulated regions to be modulated in the second semiconductor material regions, wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions, since Matsuura '534 teaches of a photonic crystal apparatus comprising charge modulated regions to be modulated in the second semiconductor

material regions, wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions, for the purpose of providing the ability to selectively introduce or remove defects in the photonic crystal, therefore compensating for natural imperfections and permitting the propagation, confinement, or both of selected wavelengths, and allowing modes of light in the structure to be changed or tuned.

8. Regarding **claim 2**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Matsuura '534 further teaches a photonic crystal apparatus wherein the effective photonic band gap of the photonic crystal lattice is modulated in response to a refractive index in the second semiconductor material that is modulated in response to the charge modulated regions (Figs. 1-15; sec. 0013-0015, 0022-0025, wherein applying an electric field to the dielectric to adjust the arrangement of the dielectrics in the crystal yields changes in the refractive index).

9. Regarding **claim 3**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Matsuura '534 further teaches a photonic crystal apparatus wherein the effective photonic band gap of the photonic crystal lattice is modulated in response to an effective hole radius of each of the plurality of holes that is modulated in response to the charge modulated regions (Figs. 1-15; sec. 0019, 0022-0025, 0029-0032, wherein the movement of the pillars 31 changes the space between each pillar 31 and therefore the radius of each hole).

10. Regarding **claim 4**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Matsuura '534 further teaches a photonic crystal apparatus wherein the optical beam has a plurality of wavelengths including a first wavelength and a second wavelength, wherein one of the first and second wavelengths of the optical beam is allowed to propagate through the photonic crystal lattice at a time in response to the modulated effective photonic band gap of the photonic crystal lattice (sec. 0002, 0013-0015, 0019-0025, 0029-0032, wherein wavelengths can be selectively confined, propagated, or both in response to an electric field being applied to the lattice).

11. Regarding **claim 5**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Matsuura '534 further teaches a photonic crystal apparatus wherein a voltage signal is coupled to be applied to the second semiconductor material regions relative to the first semiconductor material to induce charge modulated regions to modulate the effective photonic band gap of the photonic crystal lattice (Figs. 1-15; sec. 0059, wherein a voltage is coupled to both the base 33 and the pillars 31 to induce charge modulated regions to modulate the effective photonic band gap, i.e. change the periodicity of the lattice).

12. Regarding **claim 6**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Matsuura '534 further teaches a photonic crystal apparatus wherein a current signal is coupled to be injected through the second semiconductor material regions to induce charge modulated regions to modulate the effective photonic band gap of the

photonic crystal lattice (Figs. 1-15; sec. 0059, wherein current flows through the second semiconductor material because of the potential difference established, to induce charge modulated regions to modulate the effective photonic band gap).

13. Regarding **claim 8**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Tokushima '360 further discloses the first and second semiconductor materials including silicon (Figs. 1, 4; col. 4, lines 56-63; col. 7, line 20-col. 8, line 36, wherein the first semiconductor material 1/31 is Si and the second semiconductor material 2/34 is SiO2).

14. Regarding **claim 10**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Tokushima '360 further discloses each of the plurality of holes (13) being filled with a material having an index of refraction that is substantially different that an index of refraction of the first semiconductor material (Fig. 2; col. 5, lines 30-43, wherein the holes are filled with air and the elements 11 are made of GaAs, both with different indices of refraction, since the dielectric constant is directly related to the index of refraction).

15. Regarding **claim 12**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, and Tokushima '360 further discloses an optical waveguide included in the first semiconductor material through the photonic crystal lattice, the optical beam to be directed through the optical waveguide and through the photonic crystal lattice (Fig. 5; col. 9, lines 23-44).

Matsuura '534 also teaches an optical waveguide included in the first semiconductor material through the photonic crystal lattice, the optical beam to be directed through the optical waveguide and through the photonic crystal lattice (sec. 0090-0092).

Regarding **claim 13**, Tokushima '360 discloses a method comprising: directing an optical beam through a photonic crystal in a first semiconductor material (Figs. 2-3; col. 5, lines 9-48, wherein light is directed through a photonic crystal in a first semiconductor material GaAs), the first semiconductor material having a plurality of holes defined in the first semiconductor material (Fig. 2-3; col. 5, lines 9-48; col. 6, lines 33-40, wherein the holes are in between the elements 11, and in Fig. 3, between the columns 23), the plurality of holes periodically arranged in the first semiconductor material with a hole pitch and a hole radius to define the photonic crystal lattice (Fig. 2; col. 1, lines 24-30, 40-54; col. 4, lines 1-10, wherein the hole pitch is represented with the lattice constant a and the hole radius is represented with the radius r), and also teaches second semiconductor material regions (dielectric layer 24, made of second dielectric material 12, SiO2) disposed proximate to and insulated from respective inside surfaces of the plurality of holes defined in the first semiconductor material (Figs. 2, 3; col. 5, lines 9-48; col. 6, lines 33-40, wherein the second semiconductor material region 24 between the two middle elements 11 in Fig. 3C-1 is insulated from the inside surfaces of the plurality of holes defined by the first semiconductor material GaAs and elongated elements 11), but does not specifically disclose modulating charge concentrations in charge modulated regions in second semiconductor material regions disposed proximate to and insulated from respective inside surfaces of the plurality of holes defined in the first semiconductor material, or modulating an effective photonic band gap

of the photonic crystal lattice in response to the modulated charge concentrations, or modulating the optical beam directed through the photonic crystal lattice in response to the modulated effective band gap.

In the same field of endeavor of photonic crystal lattice devices, Matsuura '534 teaches modulating an effective photonic band gap of the photonic crystal lattice in response to the modulated charge concentrations (sec. 0002, 0007-0009, 0019-0025, 0059, 0063, wherein the effective photonic band gap is modulated in response to the modulated charge concentrations provided by the applied voltage to the pillars 31); modulating the optical beam directed through the photonic crystal lattice in response to the modulated effective band gap (sec. 0007-0009, 0019-0025, wherein the beam is modulated in response to the modulated bad gap, which in turn is modulated by the applied voltage); and modulating charge concentrations in charge modulated regions in second semiconductor material regions disposed proximate to inside surfaces of the plurality of holes defined in the first semiconductor material (Figs. 1-15; sec. 0013, 0019-0025, 0059-0060, 0063, wherein charge concentrations on the pillars 31 are modulated), for the purpose of providing the ability to selectively introduce or remove defects in the photonic crystal, therefore compensating for natural imperfections and permitting the propagation, confinement, or both of selected wavelengths, and allowing modes of light in the structure to be changed or tuned (sec. 0022-0025, 0063).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made for the method of Tokushima '360 to further include modulating an effective photonic band gap of the photonic crystal lattice in response to the modulated charge concentrations, modulating the optical beam directed through the photonic crystal lattice in

response to the modulated effective band gap, and modulating charge concentrations in charge modulated regions in second semiconductor material regions disposed proximate to and insulated from respective inside surfaces of the plurality of holes defined in the first semiconductor material, since Matsuura '534 teaches modulating charge concentrations in charge modulated regions in second semiconductor material regions disposed proximate to inside surfaces of the plurality of holes defined in the first semiconductor material, and further teaches modulating an effective photonic band gap of the photonic crystal lattice in response to the modulated charge concentrations and modulating the optical beam directed through the photonic crystal lattice in response to the modulated effective band gap, for the purpose of providing the ability to selectively introduce or remove defects in the photonic crystal, therefore compensating for natural imperfections and permitting the propagation, confinement, or both of selected wavelengths, and allowing modes of light in the structure to be changed or tuned.

16. Regarding **claim 14**, Tokushima '360 and Matsuura '534 disclose and teach of a method as shown above, and Matsuura '534 further teaches modulating a refractive index in the second semiconductor material in response to modulating the charge concentrations in the charge modulated regions in the second semiconductor material regions (Figs. 1-15; sec. 0013-0015, 0022-0025, wherein applying an electric field to the dielectric pillar 31 to adjust the arrangement of the dielectrics in the crystal yields changes in the refractive index).

17. Regarding **claim 15**, Tokushima '360 and Matsuura '534 disclose and teach of a method as shown above, and Matsuura '534 further teaches modulating an effective hole radius of each

of the plurality of holes in response to modulating the charge concentrations in the charge modulated regions in the second semiconductor material regions (Figs. 1-15; sec. 0019, 0022-0025, 0029-0032, 0059, wherein the movement and therefore modulation – due to the applied voltage – of the pillars 31 changes the space between each pillar 31 and therefore the radius of each hole).

18. Regarding **claim 16**, Tokushima '360 and Matsuura '534 disclose and teach of a method as shown above, and Matsuura '534 further teaches a method wherein modulating the optical beam through the photonic crystal lattice comprises selectively blocking one wavelength of the optical beam from propagating through the photonic crystal in response to the modulated effective band gap of the photonic crystal lattice (sec. 0002, 0013-0015, 0019-0025, 0029-0032, wherein wavelengths can be selectively confined, propagated, or both in response to an electric field being applied to the lattice).

19. Regarding **claim 17**, Tokushima '360 and Matsuura '534 disclose and teach of a method as shown above, and Matsuura '534 further teaches a method allowing another wavelength of the optical beam to propagate through the photonic crystal lattice while selectively blocking one wavelength of the optical beam from propagating through the photonic crystal in response to the modulated effective band gap of the photonic crystal lattice (sec. 0002, 0013-0015, 0019-0025, 0029-0032, wherein wavelengths can be selectively confined/blocked, propagated, or both in response to an electric field being applied to the lattice).

20. Regarding **claim 18**, Tokushima '360 and Matsuura '534 disclose and teach of a method as shown above, and Matsuura '534 further teaches a method wherein modulating charge concentrations in the charge modulated regions in the second semiconductor material regions comprises modulating a voltage signal applied to the second semiconductor material regions relative to the first semiconductor material (Figs. 1-15; sec. 0059, wherein a voltage is coupled to both the base 33 and the pillars 31 to induce charge modulated regions to modulate the effective photonic band gap, i.e. change the periodicity of the lattice).

21. Regarding **claim 19**, Tokushima '360 and Matsuura '534 disclose and teach of a method as shown above, and Matsuura '534 further teaches a method wherein modulating charge concentrations in the charge modulated regions in the second semiconductor material regions comprises modulating a current signal injected through the second semiconductor material regions (Figs. 1-15; sec. 0059, wherein current flows through the second semiconductor material because of the potential difference established).

22. **Claims 7 and 9** are rejected under 35 U.S.C. 103(a) as being unpatentable over Tokushima (US 6,466,360, Tokushima '360) in view of Matsuura et al. (US 2004/0213534, Matsuura '534), as applied to independent **claim 1** above, and further in view of Delwala (US 6,891,985, hereinafter Delwala '985).

23. Regarding **claim 7**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, but do not specifically disclose or teach of an apparatus further comprising insulating material disposed between the second semiconductor material regions and

the first semiconductor material to insulate each respective second semiconductor material region from the first semi conductor material.

In the same field of endeavor of optical waveguides, Delwala '985 teaches of an apparatus comprising insulating material (gate oxide layer 110) disposed between the second semiconductor material regions (polysilicon layer 191) and the first semiconductor material (silicon layer 160) to insulate each respective second semiconductor material region from the first semi conductor material (Figs. 3-4; col. 3, lines 31-62; col. 11, line 28-col. 12, line 42, wherein Delwala '985 teaches that a gate oxide layer is an electrically insulating material) for the purpose of defining where light flows in the optical waveguide (col. 11, line 28-col. 12, line 42).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the apparatus of Tokushima '360 and Matsuura '534 to further comprise insulating material disposed between the second semiconductor material regions and the first semiconductor material to insulate each respective second semiconductor material region from the first semi conductor material, since Delwala '985 teaches of an apparatus comprising insulating material disposed between the second semiconductor material regions and the first semiconductor material to insulate each respective second semiconductor material region from the first semi conductor material for the purpose of defining where light flows in the optical waveguide.

24. Regarding **claim 9**, Tokushima '360 and Matsuura '534 disclose and teach of an apparatus as shown above, but do not specifically disclose or teach of an apparatus wherein the second semiconductor material includes polysilicon.

In the same field of endeavor of optical waveguides, Delwala '985 teaches of an apparatus wherein the second semiconductor material (polysilicon layer 191) includes polysilicon (Figs. 3-4; col. 11, line 28-col. 12, line 42, wherein polysilicon layer 191 is the second semiconductor material and silicon layer 160 is the first semiconductor material) for the purpose of limiting light absorption and defining where the light flows in the optical waveguide (col. 11, line 28-col. 12, line 42).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the apparatus of Tokushima '360 and Matsuura '534 to include polysilicon as the second semiconductor material, since Delwala '985 teaches of an apparatus wherein the second semiconductor material includes polysilicon for the purpose of limiting light absorption and defining where the light flows in the optical waveguide.

Tokushima '360, Matsuura '534, and Delwala '985 disclose and teach of an apparatus as shown above, and Delwala '985 further teaches the first semiconductor material (silicon layer 160) including crystal silicon (Figs. 3-4; col. 11, line 28-col. 12, line 42).

25. **Claim 11** is rejected under 35 U.S.C. 103(a) as being unpatentable over Tokushima (US 6,466,360, Tokushima '360) in view of Matsuura et al. (US 2004/0213534, Matsuura '534), as applied to independent **claim 1** above, and further in view of Gunn, III et al. (US 6,990,257, hereinafter Gunn '257).

Regarding **claim 11**, Tokushima '360 and Matsuura '534 disclose and teach of an

apparatus as shown above, but do not specifically disclose or teach of an apparatus wherein capacitive structures are defined by the second semiconductor material regions insulated from the first semiconductor material.

In the same field of endeavor of optical waveguides, Gunn '257 teaches of an apparatus (waveguide 400) wherein capacitive structures are defined by the second semiconductor material regions insulated from the first semiconductor material (Fig. 7; col. 14, line 8-col. 15, line 24, wherein capacitive structures are defined by the polysilicon strip 410 – the second semiconductor material region – insulated via the thin transition layer 415, made of an insulative silicon dioxide, from the silicon slab 405 – the first semiconductor material) for the purpose of altering the refractive index of the semiconductor materials and therefore altering the optical properties of the waveguide (col. 14, line 8-col. 15, line 24).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the apparatus of Tokushima '360 and Matsuura '534 to have capacitive structures defined by the second semiconductor material regions insulated from the first semiconductor material, since Gunn '257 teaches of an apparatus wherein capacitive structures are defined by the second semiconductor material regions insulated from the first semiconductor material for the purpose of altering the refractive index of the semiconductor materials and therefore altering the optical properties of the waveguide.

26. **Claims 20-28** are rejected under 35 U.S.C. 103(a) as being unpatentable over Tokushima (US 6,466,360, Tokushima '360) in view of Matsuura et al. (US 2004/0213534, Matsuura '534), and further in view of Gunn, III et al. (US 6,990,257, Gunn '257).

Regarding **claim 20**, Tokushima '360 discloses a system comprising: an optical device including: a photonic crystal lattice in a first semiconductor material (Fig. 2; col. 5, lines 9-48, wherein the photonic crystal lattice is made up of elongated elements 11 formed of GaAs), the first semiconductor material having a plurality of holes (bores filled with air 13 located between the vertical elements 11) defined in the first semiconductor material (Figs. 2, 3; col. 5, lines 9-48, wherein the first dielectric semiconductor material GaAs has a plurality of air filled bores 13 defined therein), the plurality of holes periodically arranged in the first semiconductor material with a hole pitch and a hole radius to define the crystal lattice structure (Fig. 2; col. 1, lines 24-30, 40-54; col. 4, lines 1-10, wherein the hole pitch is represented with the lattice constant a and the hole radius is represented with the radius r); second semiconductor material regions (dielectric layer 24, made of second dielectric material 12, SiO2) disposed proximate to and insulated from respective inside surfaces of the plurality of holes defined in the first semiconductor material (Figs. 2, 3; col. 5, lines 9-48; col. 6, lines 33-40, wherein the second semiconductor material region 24 between the two middle elements 11 in Fig. 3C-1 is insulated from the inside surfaces of the plurality of holes defined by the first semiconductor material GaAs and elongated elements 11), but does not specifically disclose charge modulated regions to be modulated in the second semiconductor material regions, the optical beam directed through the photonic crystal lattice modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions.

In the same field of endeavor of photonic crystal lattice devices and systems, Matsuura '534 teaches charge modulated regions to be modulated in the second semiconductor material

regions (Figs. 1-15; sections 0019, 0022-25, 0029-0032, 0059, wherein the charge modulated regions are the pillars 31), wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions (Figs. 1-15; sec. 0002, 0007-0009, 0019, 0022-25, 0029-0032, 0059, wherein the beam that is directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap, the effective photonic band gap modulated in response to the deformation or movement of the pillars 31 which are electrically modulated), for the purpose of providing the ability to selectively introduce or remove defects in the photonic crystal, therefore compensating for natural imperfections and permitting the propagation, confinement, or both of selected wavelengths, and allowing modes of light in the structure to be changed or tuned (sec. 0022-0025, 0063).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the system of Tokushima '360 to further comprise charge modulated regions to be modulated in the second semiconductor material regions, wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions, since Matsuura '534 teaches of a photonic crystal system comprising charge modulated regions to be modulated in the second semiconductor material regions, wherein an optical beam directed through the photonic crystal lattice is modulated in response to a modulated effective photonic band gap of the photonic crystal lattice, the effective photonic band gap modulated in response to the charge modulated regions, for the

purpose of providing the ability to selectively introduce or remove defects in the photonic crystal, therefore compensating for natural imperfections and permitting the propagation, confinement, or both of selected wavelengths, and allowing modes of light in the structure to be changed or tuned.

Tokushima '360 and Matsuura '534 disclose and teach of a system as shown above, but do not specifically disclose or teach of an optical transmitter to transmit an optical beam, an optical receiver, and an optical device optically coupled between the optical transmitter and the optical receiver.

In the same field of endeavor of optical waveguide systems, Gunn '257 teaches of a system comprising an optical transmitter to transmit an optical beam (laser diode that emits light), an optical receiver (phones, computers), and an optical device (waveguide) optically coupled between the optical transmitter and the optical receiver (col. 1, lines 20-50, wherein the waveguide is used as a connection between the transmitter and receiver to propagate the optical signals) for the purpose of providing rapid transportation of information from one location to another (col. 1, lines 20-50).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the system of Tokushima '360 and Matsuura '534 to further comprise an optical transmitter to transmit an optical beam, an optical receiver, and an optical device optically coupled between the optical transmitter and the optical receiver since Gunn '257 teaches of a system comprising an optical transmitter to transmit an optical beam, an optical receiver, and an optical device optically coupled between the optical transmitter and the optical

receiver for the purpose of providing rapid transportation of information from one location to another.

27. Regarding **claim 21**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a system as shown above, and Matsuura '534 further teaches a photonic crystal system wherein the effective photonic band gap of the photonic crystal lattice is modulated in response to a refractive index in the second semiconductor material that is modulated in response to the charge modulated regions (Figs. 1-15; sec. 0013-0015, 0022-0025, wherein applying an electric field to the dielectric to adjust the arrangement of the dielectrics in the crystal yields changes in the refractive index).

28. Regarding **claim 22**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a system as shown above, and Matsuura '534 further teaches a photonic crystal system wherein the effective photonic band gap of the photonic crystal lattice is modulated in response to an effective hole radius of each of the plurality of holes that is modulated in response to the charge modulated regions (Figs. 1-15; sec. 0019, 0022-0025, 0029-0032, wherein the movement of the pillars 31 changes the space between each pillar 31 and therefore the radius of each hole).

29. Regarding **claim 23**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a photonic crystal system as shown above, and Matsuura '534 further teaches a photonic crystal apparatus wherein the optical beam has a plurality of wavelengths including a first wavelength and a second wavelength, wherein one of the first and second wavelengths of the

optical beam is allowed to propagate through the photonic crystal lattice at a time in response to the modulated effective photonic band gap of the photonic crystal lattice (sec. 0002, 0013-0015, 0019-0025, 0029-0032, wherein wavelengths can be selectively confined, propagated, or both in response to an electric field being applied to the lattice).

30. Regarding **claim 24**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a photonic crystal system as shown above, and Matsuura '534 further teaches a photonic crystal system wherein the optical device is coupled to receive a voltage signal to be applied to the second semiconductor material regions relative to the first semiconductor material to induce charge modulated regions to modulate the effective photonic band gap of the photonic crystal lattice (Figs. 1-15; sec. 0059, wherein a voltage is coupled to both the base 33 and the pillars 31 to induce charge modulated regions to modulate the effective photonic band gap, i.e. change the periodicity of the lattice).

31. Regarding **claim 25**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a photonic crystal system as shown above, and Matsuura '534 further teaches a photonic crystal system wherein the optical device is coupled to receive a current signal to be injected through the second semiconductor material regions to induce charge modulated regions to modulate the effective photonic band gap of the photonic crystal lattice (Figs. 1-15; sec. 0059, wherein current flows through the second semiconductor material because of the potential difference established, to induce charge modulated regions to modulate the effective photonic band gap).

32. Regarding **claim 26**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a photonic crystal system as shown above, and Gunn '257 further teaches insulating material (silicon dioxide layer 415) disposed between the second semiconductor material regions (polysilicon strip 410) and the first semiconductor material (silicon slab 405) to insulate each respective second semiconductor material region from the first semiconductor material (col. 14, lines 8-55).

33. Regarding **claim 27**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a photonic crystal system as shown above, and Tokushima '360 further discloses each of the plurality of holes (13) being filled with a material having an index of refraction that is substantially different that an index of refraction of the first semiconductor material (Fig. 2; col. 5, lines 30-43, wherein the holes are filled with air and the elements 11 are made of GaAs, both with different indices of refraction, since the dielectric constant is directly related to the index of refraction).

34. Regarding **claim 28**, Tokushima '360, Matsuura '534, and Gunn '257 disclose and teach of a photonic crystal system as shown above, and Gunn '257 further teaches capacitive structures being defined by the second semiconductor material regions (polysilicon strip 410) insulated from the first semiconductor material (silicon slab 405) (col. 14, lines 8-55, wherein the two semiconductor materials act like a capacitor, charging with the application of a voltage).

Conclusion

35. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Koyama (US 6,912,334) discloses a photonic crystal optical waveguide.

36. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael P. Roberts whose telephone number is (571) 270-1288. The examiner can normally be reached on Monday-Friday 8am-4/5pm with alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ricky Mack can be reached on (571) 272-2333. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Michael Roberts
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